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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF UVALDE, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Uvalde, Uvalde County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The original hydrologic and hydraulic analyses for this study were performed by URS Company for the Federal Emergency Management Agency (FEMA), under Contract No. H-4643. The original work was completed in December 1979.

A revision to this study, which involved new hydrologic and hydraulic analyses for the Leona River and Taylor Slough, was completed by Dewberry & Davis in August 1985. These new analyses were based on a reduction in discharges resulting from a series of flood protection dams constructed by the Soil Conservation Service (SCS).

1.3 Coordination

On March 15, 1978, an initial Consultation and Coordination Officer's (CCO) meeting was held to explain the nature and purpose of the original study and to establish the geographic limits of the original study. A

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legal notice announcing the beginning of the study and stating its objectives was placed in the local newspaper. During the course of the original study, preliminary results of the original hydrologic analyses were submitted to the SCS for their review. In addition, officials of Uvalde were periodically advised of the progress of the study. The preliminary results of the original study were presented at an intermediate CCO meeting attended by representatives of FEMA, the city, and URS Company. On April 7, 1981, the results of the original study were reviewed at a final CCO meeting held with representatives of FEMA, the city, and URS Company.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Uvalde, Uvalde County, Texas. The area of study is shown on the Vicinity Map (Figure 1).

The Leona River, Cooks Slough, and Taylor Slough were studied by detailed methods for their entire lengths within the corporate limits. The Leona River and Taylor Slough were revised to reflect the effects of the recently completed SCS dams. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

2.2 Community Description

The City of Uvalde is located in the south-central portion of Uvalde County in south-central Texas, approximately 83 miles west of the City of San Antonio. The city is the county seat and commercial center of Uvalde County, serving its own population of 13,200 and the population of the surrounding area (Reference 1).

The city has a well balanced economy consisting of ranching and the production of clothes, wool, mohair, and construction materials. The Uvalde area is known as a major deer and turkey hunting area. In addition, scenic landscapes and numerous waterways attract recreational and tourist traffic.

The topography near the streams studied by detailed methods is nearly level to gently sloping, transforming to undulating and hilly in the upper portions of the streams (Reference 2). The average elevation of the city is 913 feet.

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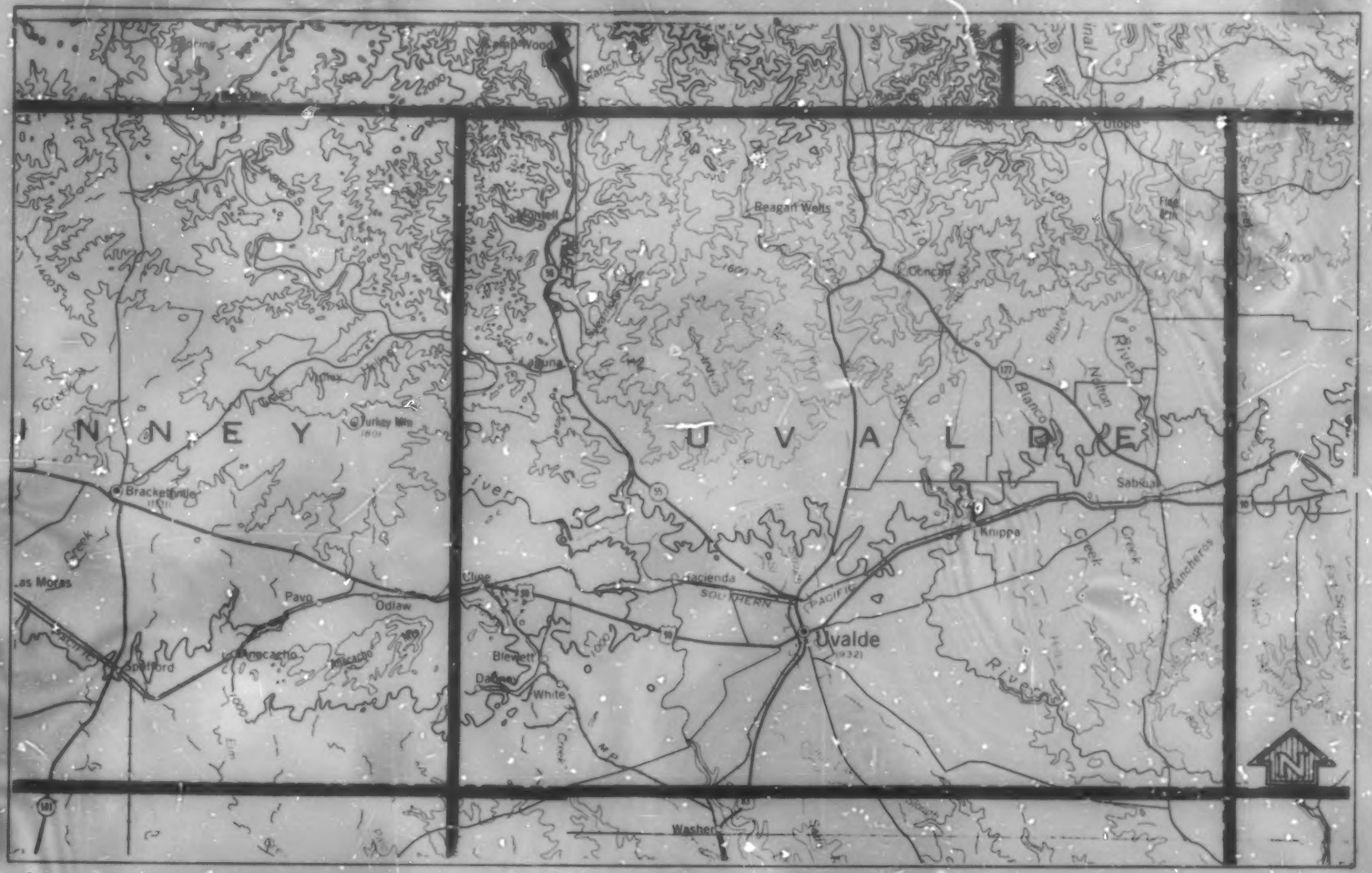

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF UVALDE, TX

(UVALDE CO.)

APPROXIMATE SCALE

0 8 16 24 MILES

VICINITY MAP

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Uvalde has a subtropical climate characterized by hot summers and mild winters. The annual precipitation is 23.2 inches, occurring mostly in the spring and fall months. Temperature extremes have ranged from 7 degrees Fahrenheit (°F) to 114°F (Reference 1). Farming is done using both irrigation and dry land farming techniques. Approximately one quarter of the cultivated land in the county is irrigated with deep wells as the primary water source.

2.3 Principal Flood Problems

Uvalde experiences flooding from the Leona River, Cocks Slough, and Taylor Slough. U. S. Route 90 crosses each of these streams. Its bridge crossings are adequate for storm flows and pose only moderate obstructions to the flow. The bridge structures at U. S. Route 83 over Cooks Slough also create only moderate obstructions. However, the structure at FM 1023 over Taylor Slough, combined with an inadequate channel upstream of the structure, creates significant backwater effects upstream to a point near U. S. Route 90. Mild gradients of streambeds and poorly defined or inadequate channels are the primary cause for most of the flooding in other areas.

The most notable flood in recent years occurred in August 1953. The total rainfall for this storm occurred over a 6.5-hour period and varied from approximately 3 inches in the upper portion of the watershed to the official 4.51 inches recorded at Uvalde. The recurrence interval of the resulting flood peak was estimated at approximately 17 years. The flood inundated approximately 5,700 acres of flood plain in the watershed, of which 500 acres are located inside the urban area of Uvalde along the Leona River and Cooks Slough (Reference 3).

A flood of greater magnitude was experienced in the summer of 1932. High-water marks just upstream of U. S. Route 90 indicated that the Leona River rose to an approximate elevation of 900 feet at that location. This was approximately 5 feet higher than the 1953 flood.

The photographs in Figures 2 through 5 show flooding which occurred on August 1, 1978. Rainfall, triggered by Tropical Storm Amelia, was only 2.2 inches in the city itself. However, rainfall in the upper portion of the Leona River watershed was sufficient to cause high water, which stranded some residents and required evacuation of others.

2.4 Flood Protection Measures

A series of dams has been constructed to provide flood protection for the City of Uvalde (Reference 3). The new dams are reflected in the revisions to the Leona River and Taylor Slough.

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FIGURE 2: Leona River at Hacienda Road.

FIGURE 3: Leona River at Lu-E1 Subdivision in northern part of Uvalde.

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FIGURE 4: Leona River in Uvalde at Studer Street.

FIGURE 5: Leona River at Deer Valley Estates (8 miles north of Uvalde on Highway 83).

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Floodwaters from the Leona River are monitored by volunteers at the upper portions of the river. When flooding is not expected to be extensive, residents in known flood-prone areas are notified directly by local police. When more extensive flooding is anticipated, warnings are also broadcast by the local radio station.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Hydrologic studies of the Uvalde area have been previously conducted by the SCS (Reference 3). Work files of these studies were obtained through the cooperation of the SCS, and the flood flows determined by the SCS were used with minor modifications as required.

The SCS TR-20 computer program was used to determine the peak flows (Reference 4). This program employs methods of estimating direct runoff from storm rainfall on procedures developed by the SCS. Rainfall and watershed data, including drainage area, time of concentration, and soil properties, were used as hydrologic parameters in calculating peak flows.

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Surface conditions were evaluated by land-use and treatment classifications. Peak flows determined by the SCS were verified at selected locations according to methods outlined in the SCS National Engineering Handbook (Reference 5). The peak flows were based on 1-, 5-, 25-, and 100-year recurrence intervals. The physical parameters of soil type and group classification were confirmed following a field reconnaissance of the watershed and were utilized by the SCS in determining a combined hydrologic parameter referred to as a curve number. A curve number of 75 was determined to be representative of the watershed of Cooks Slough, and a curve number of 78 was used for the remaining areas.

The additional parameters of drainage area and stream length were verified from a U. S. Geological Survey (USGS) toppographic map of the drainage basin (Reference 6). Rainfall data were comparable to that obtained from Technical Paper No. 40 (Reference 7).

The 10- and 50-year peak flows necessary for this study were determined by interpolating the SCS results on a log-normal basis. Similarly, the 500-year flow was extrapolated from the SCS flows.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges." The discharges for Cooks Slough are attenuated in the downstream direction due to storage in the overbank areas.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LEONA RIVER					
At Doughty Avenue, extended	47.64	1,647	2,742	3,492	6,000
At East Nopal Street	47.03	1,572	2,584	3,306	5,873
COOKS SLOUGH					
Approximately 3,000 feet downstream of U. S. Route 90	33.98	8,850	13,580	16,190	20,780
Approximately 500 feet upstream of U. S. Route 90	33.31	8,960	13,980	16,530	21,150
At Myrtle Street, extended	30.96	9,250	14,400	16,780	21,740
Just upstream of the confluence of Boone Slough	29.70	9,250	14,400	16,800	21,750

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TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TAYLOR SLOUGH					
Approximately 100 feet downstream of U. S. Route 90	16.23	1,161	2,510	3,193	4,831

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses of the streams studied by detailed methods were obtained from aerial photographs (Reference 8). Horizontal and vertical ground control was established using field surveys. The streambed elevations below the water surface were obtained by field measurement. All bridges and culverts were field checked to obtain elevation data and to determine or verify structural geometry of bridge plans obtained from the State Department of Highways and Public Transportation.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the streams studied by detailed methods were calculated by the slope/area method.

It should be noted that certain areas within the study limits for Uvalde required special consideration in determining floodwater elevations. A point of special consideration involves a "breakout" of the 50-, 100-, and 500-year frequency flows from the Cooks Slough watershed into an adjacent watershed to the west. This loss of flow occurs upstream of U. S. Route 83 from approximate stream station 2900 to station 4500. Since the two structural openings through U. S. Route 83 in the adjacent

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watershed are inadequate to handle the breakout flows, a portion of each of these overflows will re-enter the Cooks Slough watershed and discharge through the two bridge structures at U. S. Route 83 and Cooks Slough. No breakout occurs for the 10-year frequency flow.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

Stream	Channel "n"	Overbank "n"
Leona River	0.025-0.070	0.025-0.100
Cooks Slough	0.030-0.060	0.045-0.110
Taylor Slough	0.030-0.075	0.030-0.100

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 6).

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The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for the Leona River, Cooks Slough, and Taylor Slough extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Leona River								
A	265[1]	175/130[4]	812	4.3	887.1	887.1	887.1	0.0
B	2,660[1]	284	1,211	2.8	888.5	888.5	888.5	0.0
C	3,332[1]	282	1,013	3.3	891.0	891.0	891.0	0.0
D	3,900[1]	306	937	3.5	893.7	893.7	893.7	0.0
E	4,500[1]	335	1,390	2.4	895.1	895.1	895.1	0.0
F	5,110[1]	293	895	3.7	895.6	895.6	895.6	0.0
G	8,180[1]	390	1,166	2.8	899.4	899.4	899.4	0.0
H	9,240[1]	300	1,019	3.2	902.7	902.7	902.7	0.0
I	10,365[1]	309/156[4]	1,536	2.1	903.5	903.5	903.5	0.0
Cooks Slough								
A	8,650[2]	400	3,404	4.9	900.7	900.7	901.6	0.9
B	10,520[2]	630/540[4]	4,066	4.1	902.8	902.8	903.7	0.9
Taylor Slough								
A	400[3]	299	1,254	2.5	909.0	909.0	909.4	0.4
B	2,930[3]	134	915	3.5	916.6	916.6	916.7	0.1
C	3,440[3]	187	919	3.5	916.9	916.9	917.0	0.1

[1]Feet above corporate limits

[2]Feet above point 50 feet downstream of U. S. Route 83

[3]Feet above point 500 feet downstream of FM 1023

[4]Width/width within corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF UVALDE, TX

(UVALDE CO.)

FLOODWAY DATA

LEONA RIVER - COOKS SLOUGH - TAYLOR SLOUGH

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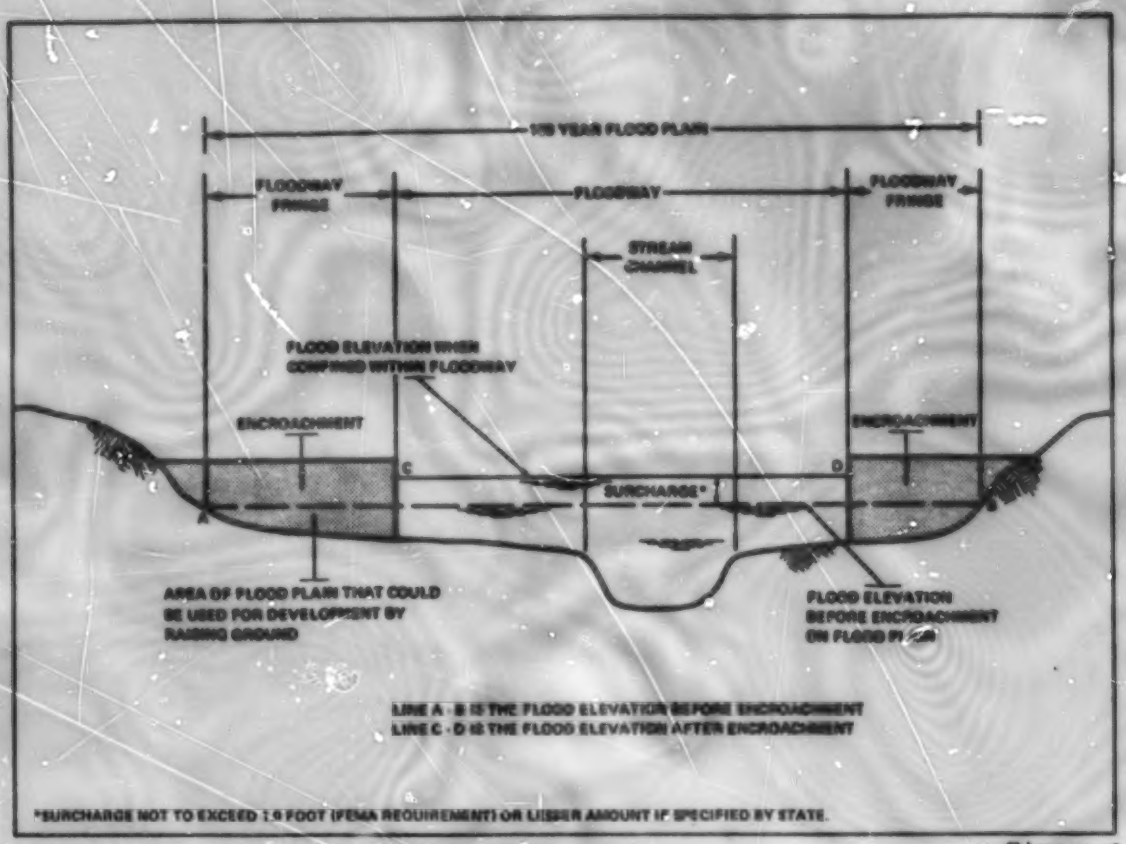
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 6

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Uvalde.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

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Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of Uvalde are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zones A2, A4, and A5: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Leona River							
Reach 1	01,02, 04	-2.4	-0.9	+2.2	025	A5	Varies
Cooks Slough							
Reach 1	03	-1.1	-0.4	+0.6	010	A2	Varies
Reach 2	01,03	-2.0	-0.6	+1.0	020	A4	Varies
Taylor Slough							
Reach 1	02,04	-2.1	-0.6	+1.7	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF UVALDE, TX
(UVALDE CO.)

FLOOD INSURANCE ZONE DATA

LEONA RIVER-COOKS SLOUGH-TAYLOR SLOUGH

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Uvalde is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

The results of this revised study supersede the results of the original study for the City of Uvalde (Reference 10).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region VI Office, Federal Center, Denton, Texas 76201.

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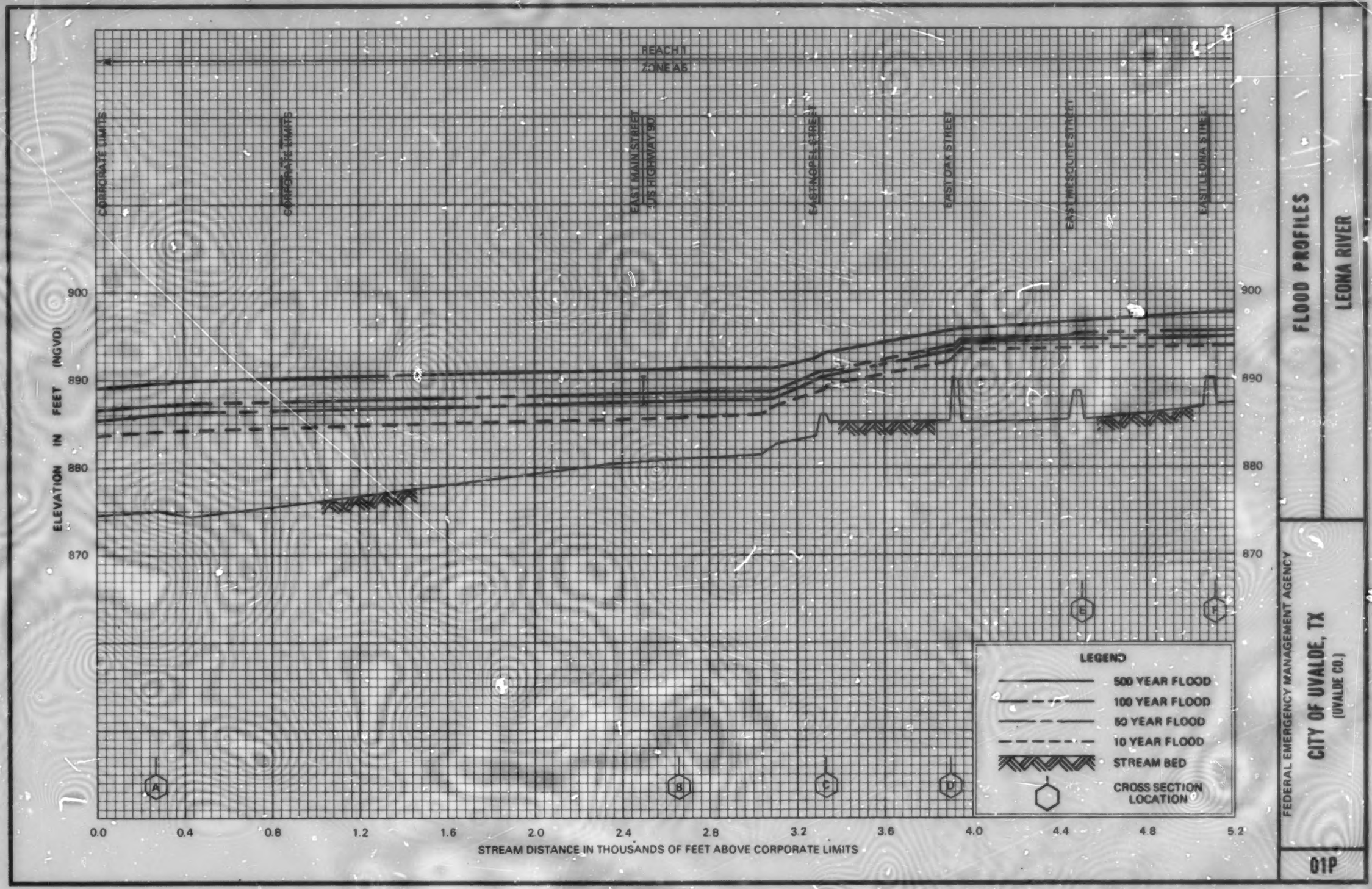

FLOOD PROFILES

LEONA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF UVALDE, TX
(UVALDE CO.)

01P

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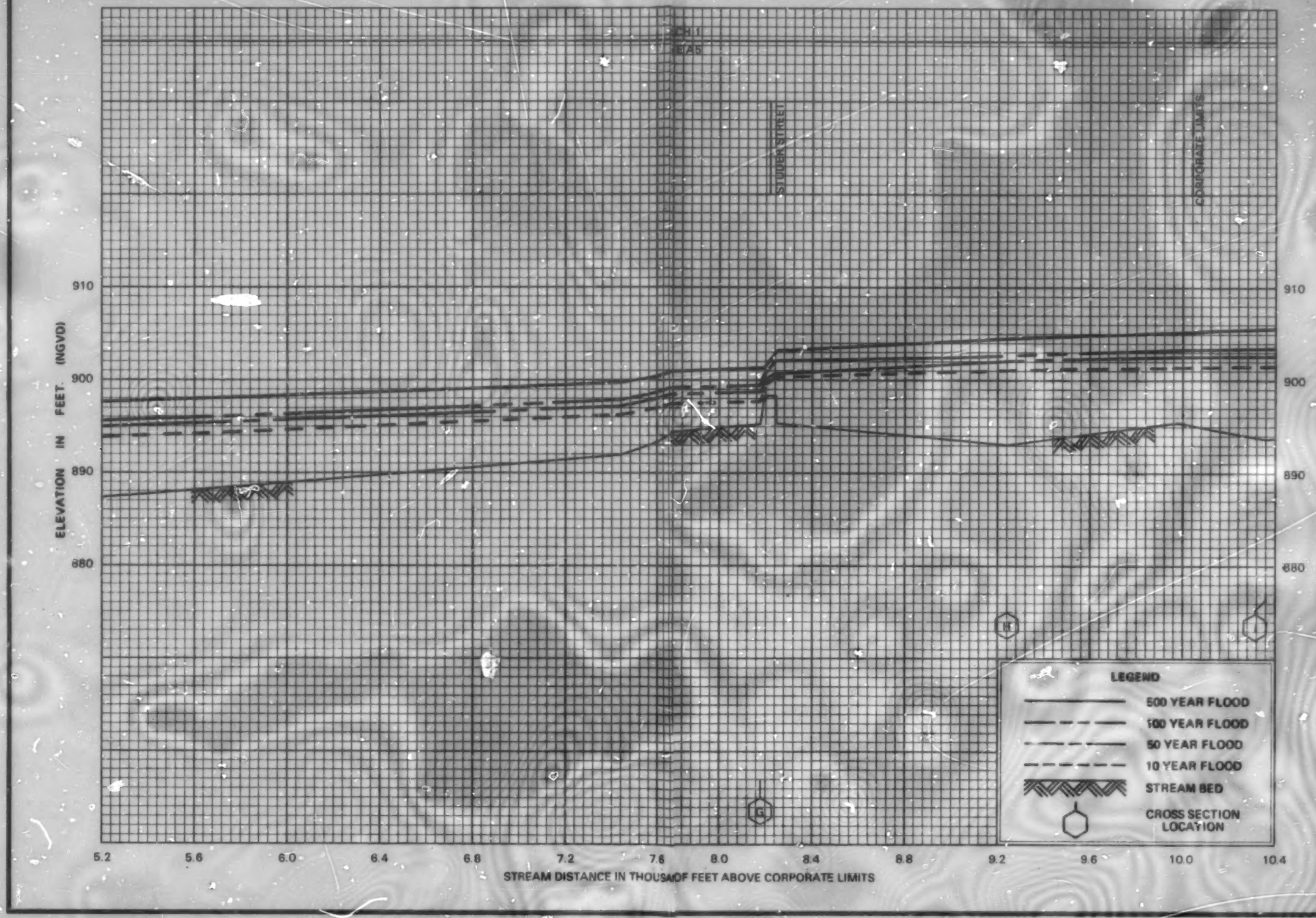

FLOOD PROFILES

LEONA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF UVALDE, TX
(UVALDE CO.)

02P

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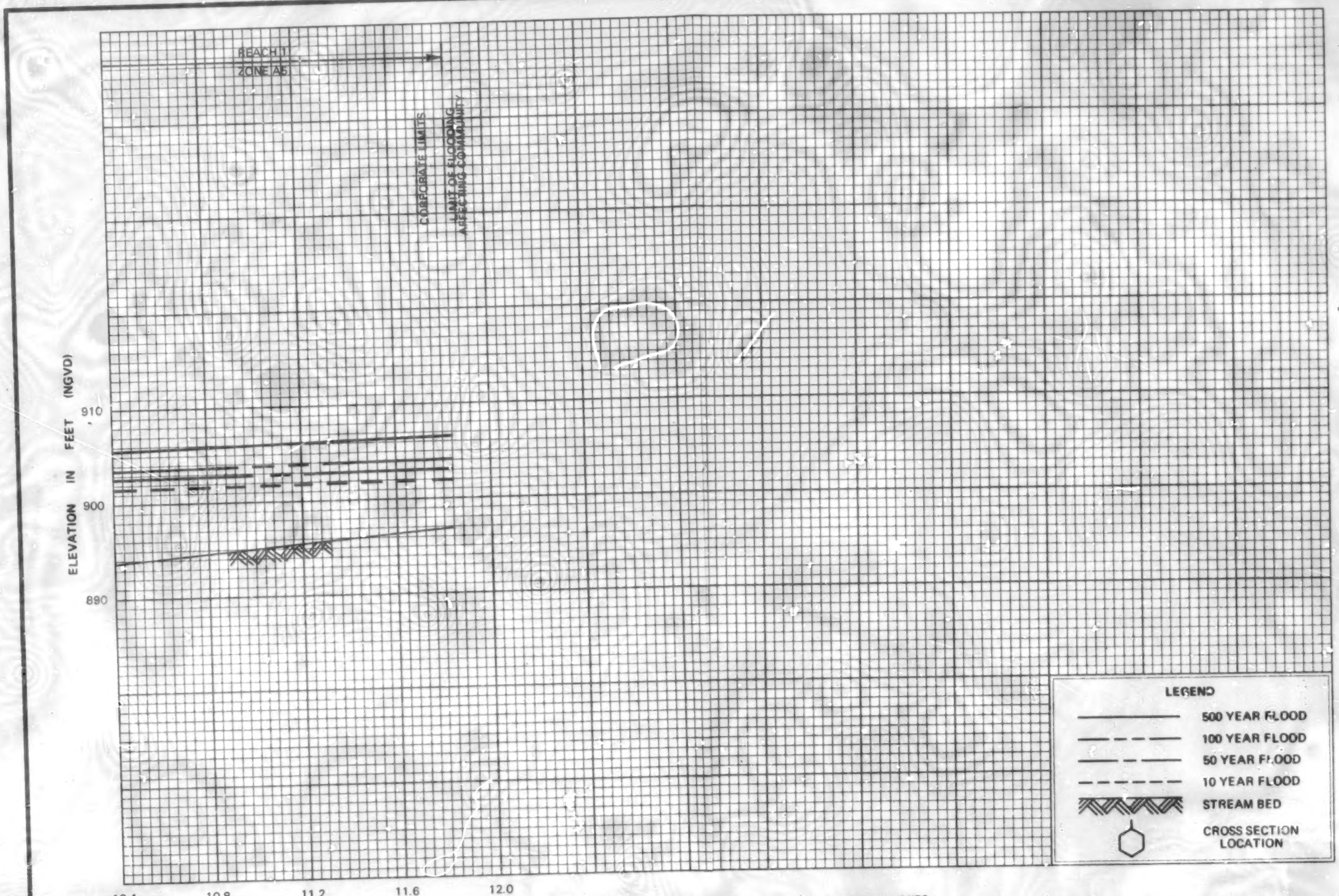

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03P

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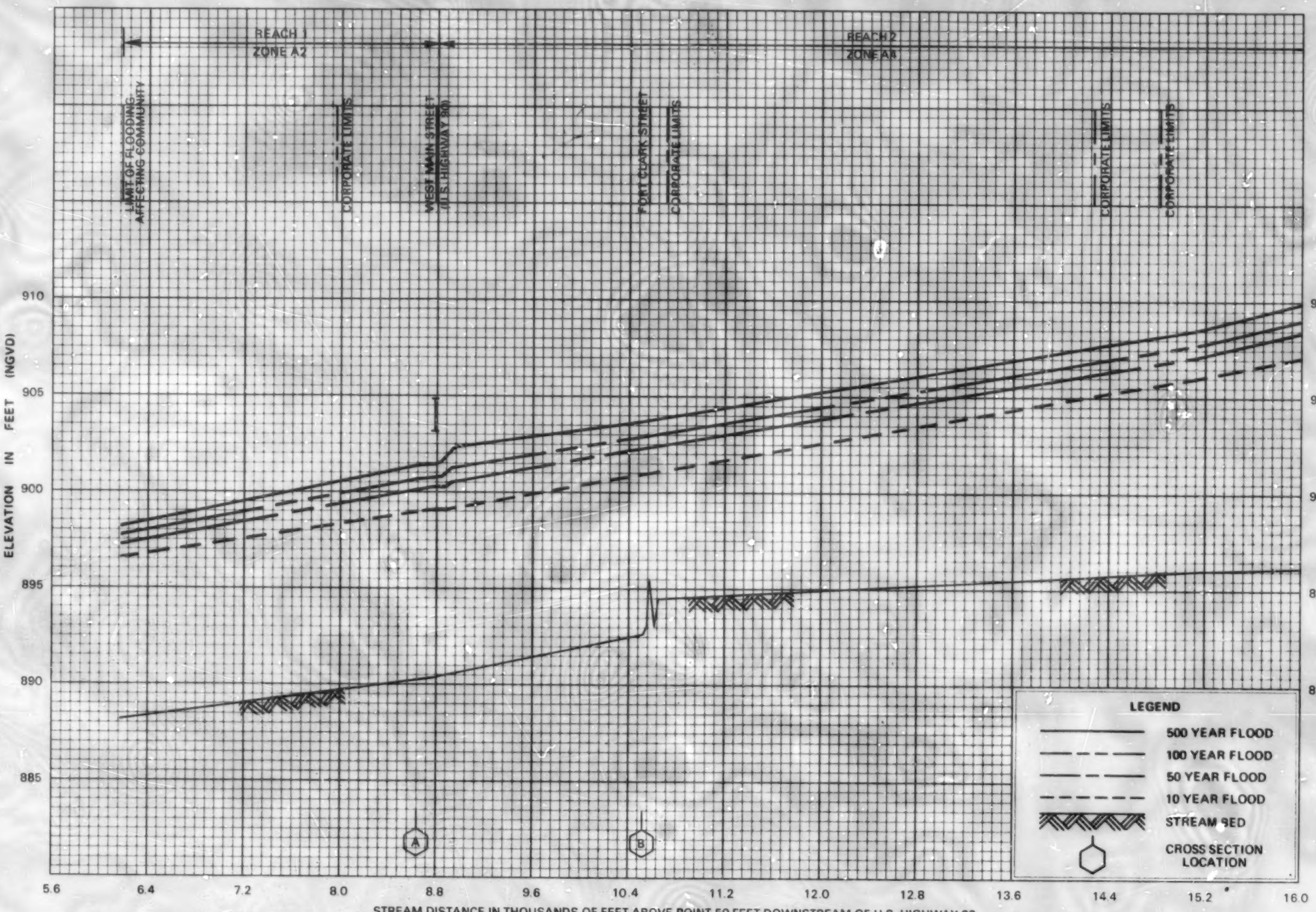

FLOOD PROFILES

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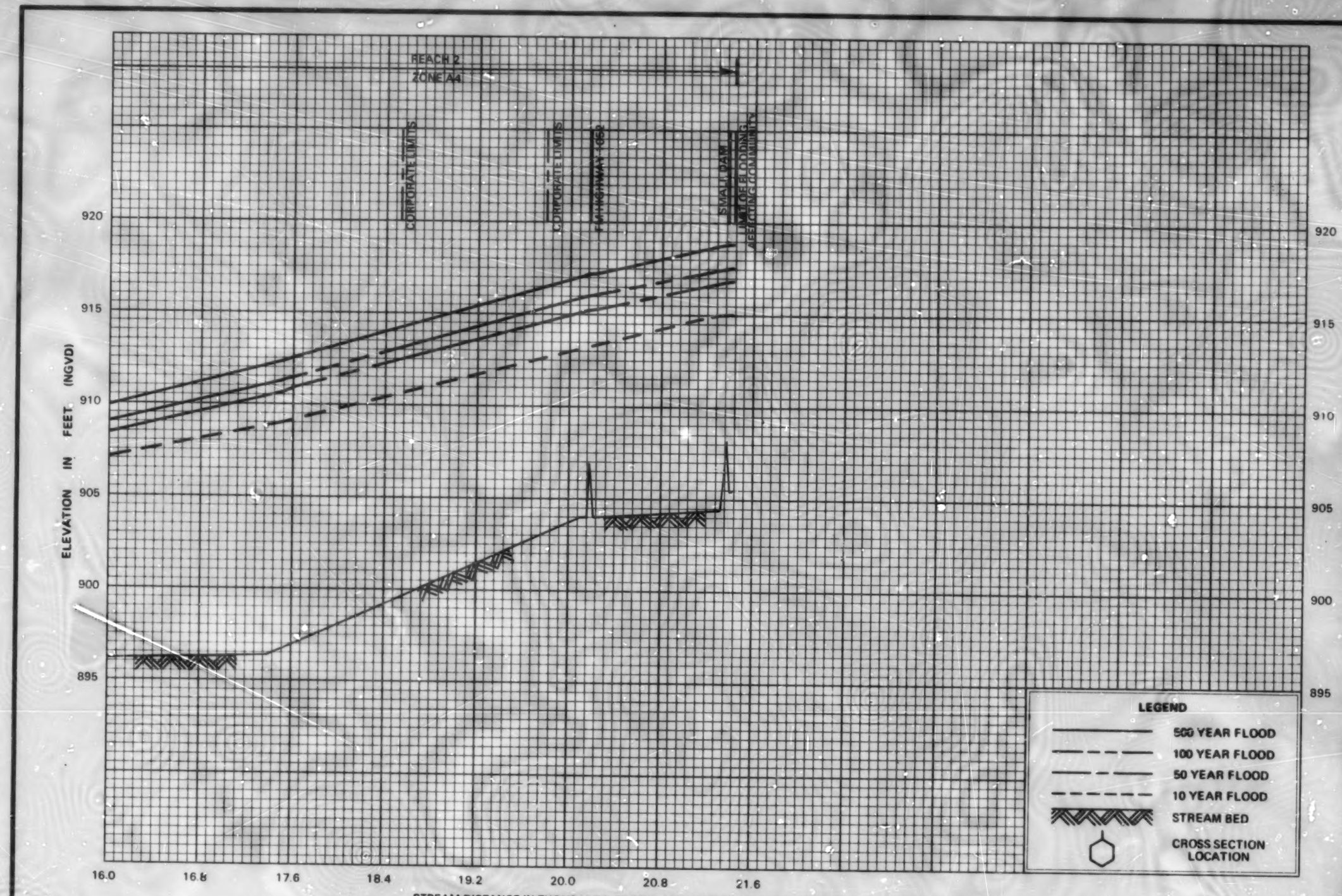

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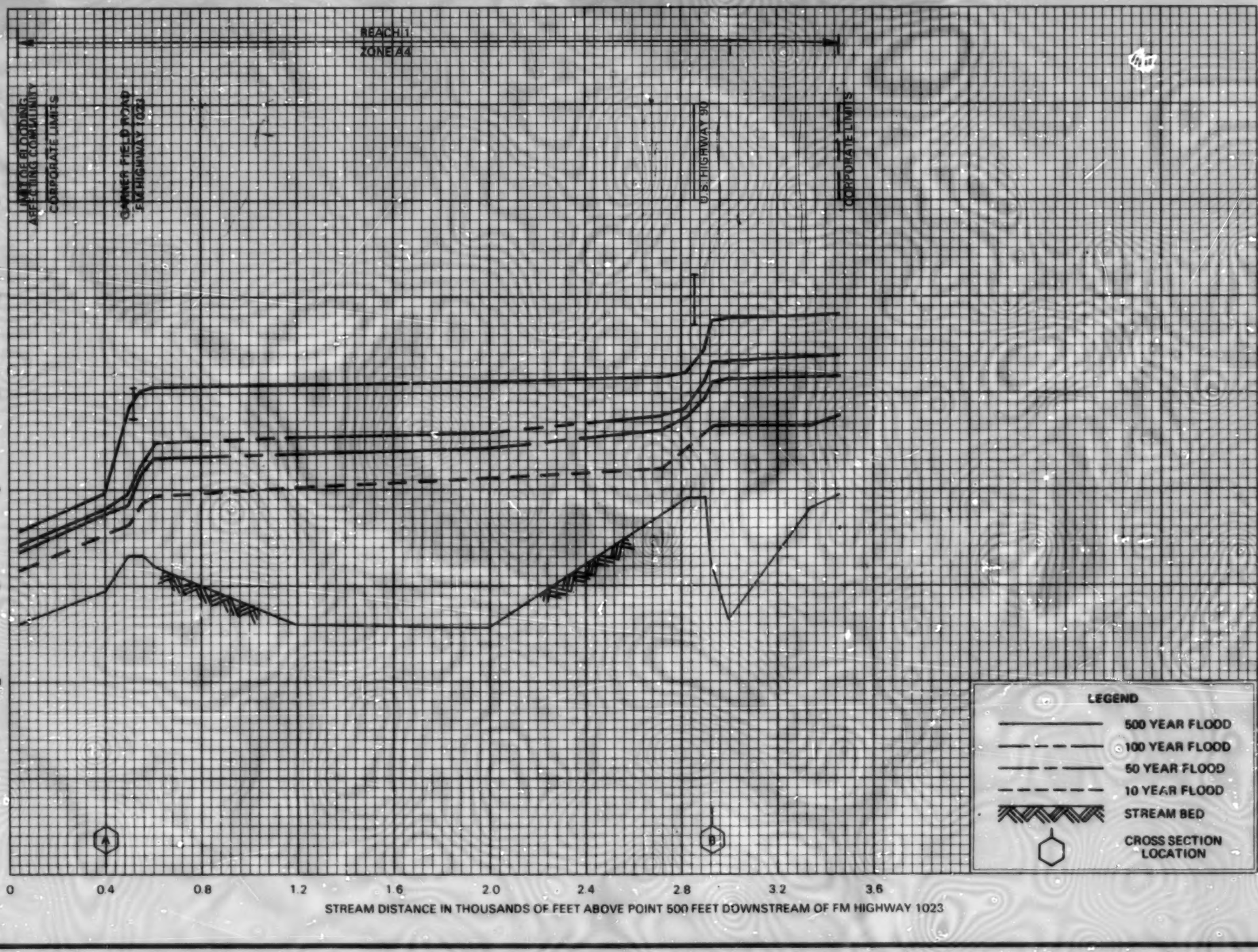

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06P

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